Brief Report

Effective antibiotic stewardship in spinal cord injury: Challenges and a way forward

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Context: Antibiotic stewardship, defined as a multidisciplinary program to reduce the misuse of antibiotics, and in turn, antibiotic resistance, is a high priority. Persons with spinal cord injury/disorder (SCI/D) are vulnerable to receiving multiple courses of antibiotics over their lifetime given frequent healthcare exposure, and have high rates of bacterial infection with multi-drug resistant organisms. Additional challenges to evaluating appropriate use of antibiotics in this population include bacterial colonization in the urine and the differences in the presenting signs and symptoms of infection. Therefore, Veterans Health Administration (VHA) facilities with SCI/D centers need effective antibiotic stewardship programs.

Results: We analyzed the results of a 2012 VHA-wide survey evaluating available antibiotic stewardship resources, and compared the resources present at facilities with SCI/D (n=23) versus non-SCI/D facilities (n=107). VHA facilities with SCI/D centers are more likely to have components of an antibiotic stewardship program that have led to reduced antibiotic use in previous studies. They are also more likely to have personnel with infectious diseases training.

Conclusion: VHA facilities with SCI/D centers have the resources needed for antibiotic stewardship. The next step will be to determine how to implement effective antibiotic stewardship tailored for this patient care setting.

Keywords: Spinal cord injury, SCI, Antimicrobial stewardship, Antibiotic stewardship, Antibiotic resistance

Introduction

Antibiotic stewardship has become a national and even global priority, as shown by recent mandates from the White House, the Centers for Disease Control and Prevention and the United Nations.[1–3] An antibiotic stewardship program is defined as a "multidisciplinary activity that includes appropriate selection, dosing, route, and duration of antimicrobial therapy".[4] The ultimate goal of such a program is to optimize clinical outcomes while minimizing unintended consequences of antibiotic use, including toxicity, the emergence of bacterial resistance, and *Clostridium difficile* infection. The argument for judicious use of antibiotics reaches beyond the public health domain to the individual's well-being. Use of antibiotics also leads to resistance in the patient's own microbiome (the tens of trillions of microbial organisms in the body, primarily in the gut), an emerging concept that has implications on total body wellness.[5]

The unique challenges of antibiotic stewardship in persons with spinal cord injury/disorder (SCI/D)

Persons with SCI/D are an especially vulnerable population in terms of risk of antibiotic overuse. Contributory factors include persistent bladder colonization, frequent health care exposure and the common use of implanted medical devices.[6] Due to the consequences of neurogenic bladder, many persons with SCI/D will need chronic bladder instrumentation, either with indwelling catheters or intermittent catheterization programs. Because of bladder instrumentation and urinary retention, the bladders of persons with SCI are frequently colonized with urinary pathogens. Depending on bladder management strategy

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Table 1: Antibiotic stewardship characteristics at facilities with SCI/D centers compared to non-SCI/D centers.

Domain	Facility factor	Facilities with SCI/D centers N=23 (%)	Facilities without SCI/D centers N=107 (%)	P value*
Antibiotic stewardship team	ID physician was part of AS team	15 (65%)	32 (30%)	<0.01
	Clinical pharmacist/clinical pharmacy specialist was part of AS team	15 (65%)	36 (34%)	0.04
	Clinical pharmacist/clinical pharmacy specialists had ID training	13 (57%)	21 (20%)	<0.01
Training programs	Pharmacy residency program	23 (100%)	79 (74%)	<0.01
	ID pharmacy residency program	6 (26%)	6 (6%)	<0.01
	ID fellowship program	22 (96%)	46 (43%)	<0.01
	Internal medicine residency program	23 (100%)	72 (67%)	<0.01
	Surgical residency program	22 (96%)	62 (58%)	<0.01
	Emergency medicine residency program	7(30%)	10 (9%)	<0.01
Antibiotic restrictions and policies	Any restriction of antibiotic use	23 (100%)	97 (91%)	0.12
	Policy to promote substitution of oral for parenteral antibiotics	23 (100%)	13 (12%)	<0.01
	Policy for de-escalation of antibiotics	21 (91%)	17 (16%)	<0.01
	Automatic ID consults for certain conditions	7 (30%)	29 (27%)	0.75
	Automatic stop orders for antibiotics duration	5 (22%)	43 (40%)	0.10
Antibiotics guidelines	Written clinical pathways/guidelines for specific conditions	21 (91%)	75 (70%)	0.01

SCI/D, spinal cord injury/disorder; AS, antibiotic stewardship; ID, infectious diseases.
*Chi-square.

used, the prevalence of asymptomatic bacteriuria is 30–90%.[7] Furthermore, diagnosis of actual infection is difficult due to the absence of traditional presenting signs and symptoms of possible UTI, and the accuracy of patients self-diagnosing a true UTI is poor, as was shown by Massa *et al*.[8] Because of the diagnostic challenge involved, the propensity to treat a "positive urinalysis or culture," even in persons without any symptoms or any urinary symptoms, is common in this population.

The frequent health care exposures persons with SCI/D often face puts them at risk for multiple antibiotic exposures and acquiring resistant health care associated pathogens. This in turn promotes emergence of resistant flora. Implanted medical devices can become infected with organisms in a biofilm; these biofilm-associated organisms are difficult to eradicate with antibiotics. Recent studies of microbiology cultures in Veterans Health Administration (VHA) revealed that persons with SCI/D have a higher percentage of multidrug resistant bacterial isolates than persons without SCI/D. In addition, extended-spectrum β-lactamase (ESBL) *Enterobacteriaceae* was associated with a longer length of hospital stay.[9–11] The incidences of *Clostridium difficile* (a known complication of frequent health care exposure and antibiotic use) is also high in this population, with significant morbidity and mortality.[12,13]

Potential Solutions

The Infectious Diseases Society of America (IDSA) guidelines on antibiotic stewardship note the need to identify stewardship strategies that are specific to special populations such as persons with SCI/D.[4] The VHA has a dedicated model of care for Veterans with SCI/D, therefore is an ideal setting in which to study SCI-specific antibiotic stewardship needs.

The first step in implementing antibiotic stewardship programs specific to SCI/D is to determine what resources are available. To answer this question, we analyzed a survey on the availability of stewardship resources administered to all VHA facilities, comparing the resources available at facilities with SCI/D centers versus non-SCI/D centers. Included in this study were 23 facilities with SCI/D centers and 107 facilities without SCI/D centers (Table 1). Facilities with SCI/D centers were more likely to have an infectious diseases (ID) physician (65%, $P < 0.01$) and a pharmacist with ID training as part of their antibiotic stewardship team than non-SCI/D centers (57%, $P < 0.01$). All the facilities with SCI/D centers had pharmacy and internal medicine residency programs, and were more likely to have ID, surgical and emergency medicine residency programs. Nearly all facilities, both SCI/D and non-SCI/D, responded yes to having "any restriction of antimicrobial use" (100% and 91%, respectively, $P = 0.12$). All the facilities with SCI/D centers had

policies to promote switching parenteral to oral agents as soon as possible, compared to 12% of non-SCI/D centers ($P < 0.01$). SCI/D center facilities were also more likely to have policies for de-escalation of antibiotics and clinical guidelines for specific conditions ($P < 0.05$ for both) than non-SCI/D facilities.

Discussion

The results of our comparison of antibiotic stewardship resources in facilities with SCI/D centers versus non-SCI/D VA facilities show that the facilities that provide SCI/D care have greater resources for antibiotic stewardship. Facilities with SCI/D care have also implemented inpatient antibiotic stewardship policies and are more likely to have antibiotic restriction policies in place.

Our findings raise two follow up questions. First, are SCI/D care providers aware of and utilizing these resources to implement SCI/D-specific antibiotic stewardship programs? Evans and colleagues administered a survey to 118 VHA SCI/D providers (which included physicians, nurse practitioners and physician assistants) querying their knowledge of antibiotic stewardship resources such as facility antibiograms and utilization of ID consult services. An antibiogram is a facility-specific listing of the percent of individual bacterial pathogens susceptible to different antibiotics. They found that nearly one-third of participants responded that they did not have access to or were unaware of a facility antibiogram, and half indicated that they never used antibiograms to determine treatment. However, nearly all (95%) of respondents felt that having access to these resources would reduce antibiotic resistance.[14]

Second, can the presence of these antibiotic stewardship resources translate to actual decreases in antibiotic overprescribing for persons with SCI/D? Chou, *et al.* correlated the results of this VHA survey on stewardship resources with actual antibiotic prescribing data.[15] They found that having at least one full-time infectious diseases physician, an infectious diseases fellowship program, a clinical pharmacist with formal infectious diseases training, frequent systematic patient-level reviews of antibiotic use and having a policy to address antimicrobial use in the context of *Clostridium difficile* infection significantly decreased facility-level antibiotic use. Facilities with SCI/D centers were more likely than the non-SCI/D facilities to have the first three of these characteristics listed (ID physicians, training programs and pharmacist). A recent review of antibiotic stewardship resources in the VHA demonstrates decreased antibiotic use since targeted stewardship initiatives began in 2012.[16] Further study is needed to correlate antibiotic use in SCI/D specific care and the presence of specific antibiotic stewardship resources and policies.

Conclusion

This work shows that VHA facilities with SCI/D centers are more likely to be staffed with key players of antibiotic stewardship programs, be a part of academic/training institutions, and have more antibiotic restriction policies than non-SCI/D center VA facilities. Previous work has shown that effective antibiotic stewardship programs reduce antibiotic use, and that SCI/D providers are receptive to filling gaps in their knowledge about available resources. The pieces are in place to develop SCI/D-focused antibiotic stewardship programs to address the threat that highly resistant organisms pose to the health of the SCI/D patient population.

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